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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER
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MALDONADO, JULIO J

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 11 18 2002

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/838,513

Applicant(s)

CHEN ET AL.

Examiner

Julio J. Maldonado

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☐ Responsive to communication(s) filed on 10 September 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☐ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

### DETAILED ACTION

1. The 35 U.S.C. 112, first paragraph rejection as set forth in paper No. 4 is withdrawn in response to applicants' request for reconsideration.
2. Claims 1-21 are pending in the application.

#### ***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

4. Claims 1, 2, 6, 7, 15, 16, 20 and 21 are rejected under 35 U.S.C. 102(a) as being Anticipated by Mouroux (The reactive formation of  $\text{TiSi}_2$  in the presence of refractory metals).

In reference to claims 1 and 15, Mouroux (Figs. 2, 9, 12-14 and 17) in a related art to the formation of titanium disilicide layers teaches providing a semiconductor substrate having silicon regions to be silicided; depositing a titanium layer directly overlying said silicon regions to be silicided; subjecting said substrate to a first annealing at a temperature less than  $700^\circ\text{C}$ , whereby said titanium is transformed to phase C40 titanium disilicide where it overlies said silicon regions and where said titanium not overlying said silicon regions is unreacted; subjecting said substrate to a second annealing whereby phase C54 titanium disilicide is grown overlying said phase C40 titanium disilicide and whereby said phase C40 titanium disilicide is transformed to

phase C54 titanium disilicide; and removing said unreacted titanium layer to complete formation of said integrated circuit (page 6-14, 17, 24-28, 30, 37 and 38).

In reference to claims 2 and 16, Mouroux teaches said silicon regions to be silicided comprising gate electrodes and associated source and gate regions (Figure 2).

In reference to claims 6, 7, 20 and 21, Mouroux teaches said second annealing is a rapid thermal annealing performed at a temperature between about 550 and 860°C for 0.5 to 2 minutes, or by furnace annealing at a temperature of between about 500 and 750°C for 5 to 60 minutes (pages 19, 27 and 28).

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 3 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mouroux.

In reference to claims 3 and 17, Mouroux teaches sputter depositing a titanium layer at a thickness rate of 0.5 nm/s (page 15). However, Mouroux fails to teach having a thickness between about 100 and 500 angstroms. The selection of the claimed range is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious)

and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). See MPEP 2144.05 III.

7. Claims 4, 5, 8-14, 18 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mouroux in view of Ishida (U.S. 5,937,325).

In reference to claims 4, 5, 18 and 19, Mouroux teaches performing a first annealing but fails to teach that the first annealing is a laser annealing using a laser having a wavelength of 1.06 nm and an energy between about 0.5 and 1.5 joules/cm<sup>2</sup>; and where said first annealing uses an Excimer laser having a wavelength of 248 nm and an energy between about 0.1 and 1.2 joules/cm<sup>2</sup>. However, Ishida (Figs.2-4) in a related method to form low resistivity titanium silicide layers teach performing a first annealing, where said annealing is a laser annealing using an Excimer laser having a wavelength of 308 nm and an energy between about 0.3 and 1.0 joules/cm<sup>2</sup> (column 4, lines 5-22). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use a laser anneal as taught by Ishida in the silicide formation method of Mouroux, since this would allow the selective formation of titanium disilicide in some regions while leaving others unreacted (column 4, lines 5-22).

Mouroux in combination with Ishida fail to teach laser annealing having a wavelength of 1.06 nm and using an Excimer laser having a wavelength of 248 nm. The selection of the claimed ranges are obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA

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1980)(discovery of optimum value of result effective variable in a known process is obvious). See MPEP 2144.05 III.

In reference to claim 8, Mouroux (Figs.2, 9, 12-14 and 17) in a related art to the formation of titanium disilicide layers teaches providing a semiconductor substrate having silicon regions to be silicided; depositing a titanium layer directly overlying said silicon regions to be silicided; subjecting said substrate to a first annealing whereby said titanium is transformed to phase C40 titanium disilicide where it overlies said silicon regions and where said titanium not overlying said silicon regions is unreacted; subjecting said substrate to a second annealing whereby phase C54 titanium disilicide is grown overlying said phase C40 titanium disilicide and whereby said phase C40 titanium disilicide is transformed to phase C54 titanium disilicide; and removing said unreacted titanium layer to complete formation of said integrated circuit (pages 6-14, 17, 24-28, 30, 37 and 38).

Mouroux fails to teach that the first annealing is a laser annealing. However, Ishida (Figs.2-4) in a related method to form low resistivity titanium silicide layers teach performing a first annealing, where said annealing is a laser annealing (column 4, lines 5-22). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use a laser anneal as taught by Ishida in the silicide formation method of Mouroux, since this would allow the selective formation of titanium disilicide in some regions while leaving others unreacted (column 4, lines 5-22).

In reference to claims 9, Mouroux teaches that said silicon regions to be silicided comprises gate electrodes and associated source and gate regions (Figure 2).

In reference to claim 10, Mouroux teaches sputter depositing a titanium layer at a thickness rate of 0.5 nm/s (page 15). However, Mouroux fails to teach that the titanium layer has a thickness between about 100 and 500 angstroms. The selection of the claimed range is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious).

In reference to claims 11 and 12, Mouroux teaches performing a first annealing but fails to teach where said first annealing is a laser annealing using a laser having a wavelength of 1.06 nm and an energy between about 0.5 and 1.5 joules/cm<sup>2</sup>; and where said first annealing uses an Excimer laser having a wavelength of 248 nm and an energy between about 0.1 and 1.2 joules/cm<sup>2</sup>. However, Ishida (Fig.2-4) in a related method to form low resistivity titanium silicide layers teach performing a first annealing, where said annealing is a laser annealing using an Excimer laser having a wavelength of 308 nm and an energy between about 0.3 and 1.0 joules/cm<sup>2</sup> (column 4, lines 5-22). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use a laser anneal as taught by Ishida in the silicide formation method of Mouroux, since this would allow the selective formation of titanium disilicide in some regions while leaving others unreacted (column 4, lines 5-22).

Mouroux in combination with Ishida fail to teach laser annealing having a wavelength of 1.06 nm and using an Excimer laser having a wavelength of 248 nm. The selection of the claimed ranges are obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious).

In reference to claims 13 and 14 Mouroux teaches that the second annealing is a rapid thermal annealing performed at a temperature between about 550 and 860°C for 0.5 to 2 minutes, or by furnace annealing at a temperature of between about 500 and 750°C for 5 to 60 minutes (pages 19, 27 and 28).

### ***Response to Arguments***

8. Applicant's arguments filed 09/10/2002 have been fully considered but they are not persuasive.

Applicants' argue, "...Mouroux requires the presence of a refractory metal such as Mo underlying the Ti layer to form a C40 phase..." and "...Mouroux requires in intervening layer of Nb or Mo..." (page 7, lines 10-21). In response to this argument, applicants assert that Mouroux teaches the presence of a refractory metal to form the C40 phase and that the preferred method to form such phase involves the presence of said intervening layer. However, Mouroux teaches that there are other methods to form the C40 phase that does not require an intervening layer, such as refractory metal



implantation (Mouroux, Fig.9 and pages 14-16). Therefore, the titanium layer is deposited "directly overlying said silicon regions to be silicided" as claimed.

### ***Conclusion***

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

10. Papers related to this application may be submitted directly to Art Unit 2823 by facsimile transmission. Papers should be faxed to Art Unit 2823 via the Art Unit 2823 Fax Center located in Crystal Plaza 4, room 3C23. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2823 Fax Center number is **(703) 305-3432**. The Art Unit 2823 Fax Center is to be used only for papers related to Art Unit 2823 applications.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Julio J. Maldonado** at **(703) 306-0098** and between the hours of 8:00 AM to 4:00 PM (Eastern Standard Time) Monday through Friday or by e-

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mail via [julio.maldonado@uspto.gov](mailto:julio.maldonado@uspto.gov). If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (703) 306-2794.

Any inquiry of a general nature or relating to the status of this application should be directed to the **Group 2800 Receptionist** at (703) 308-0956.

**Julio J. Maldonado**

Patent Examiner

Art Unit 2823

703-306-0098

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